

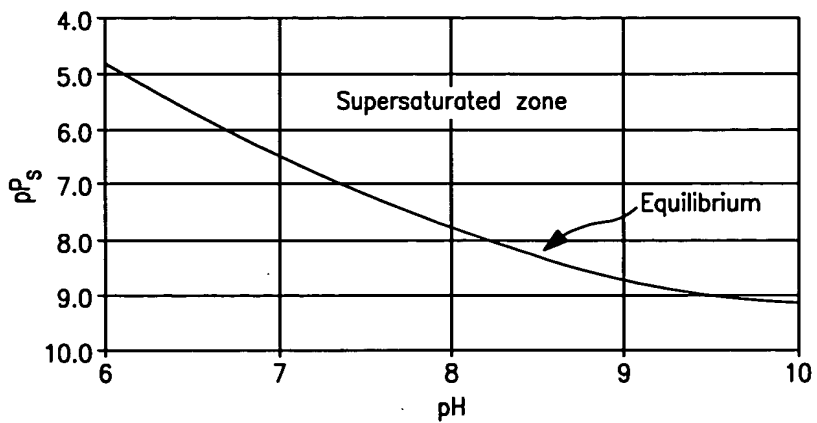


Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

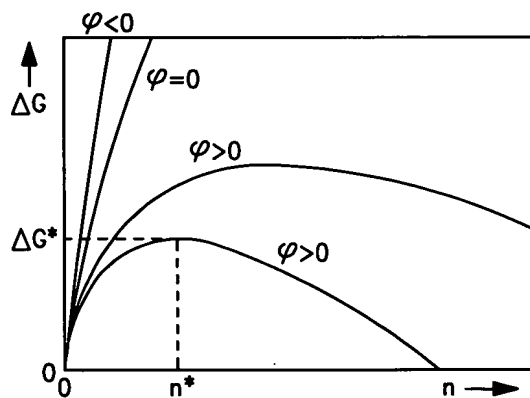
Serial No.: 10/659,239

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Variation of Equilibrium Conditional Solubility versus pH for Struvite  
(from Ohlinger et al., 1998)

FIG. 1

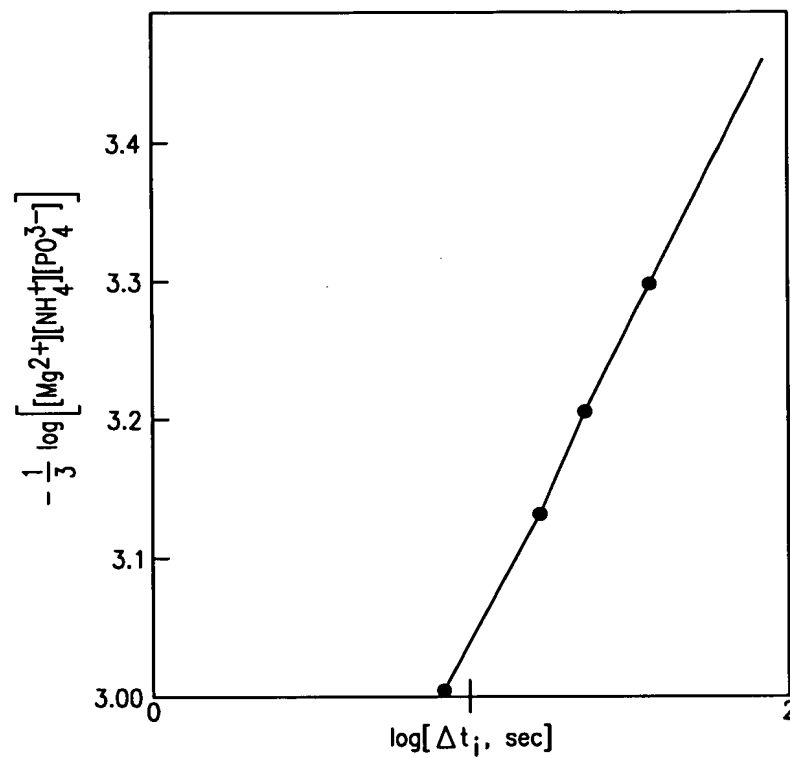


Free Energy versus Number of Particles in a Precipitating Crystal

FIG. 2

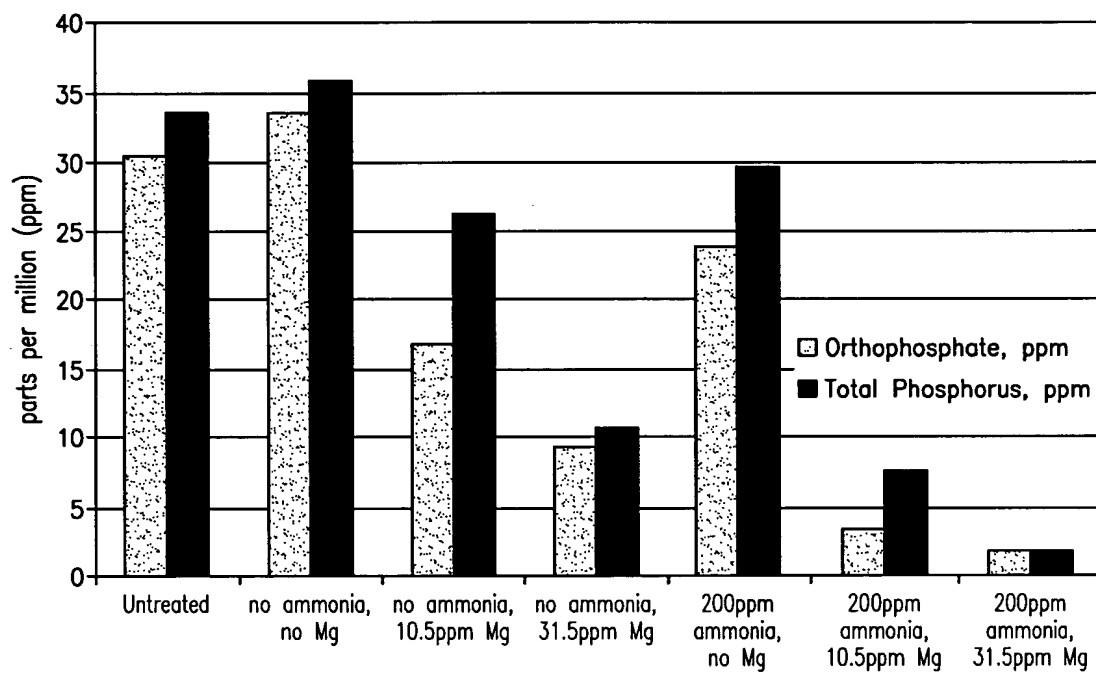
Title: APPARATUS AND METHOD FOR  
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WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
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Concentration ( $-\frac{1}{3} \log$  of Ionic Product, Mol/L) versus Induction Time (Sec) for  
Struvite Precipitation

FIG. 3



Dissolved OP and TP (ppm) in Untreated and Treated Effluent  
from Rocky Mount Lagoon

FIG. 4

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

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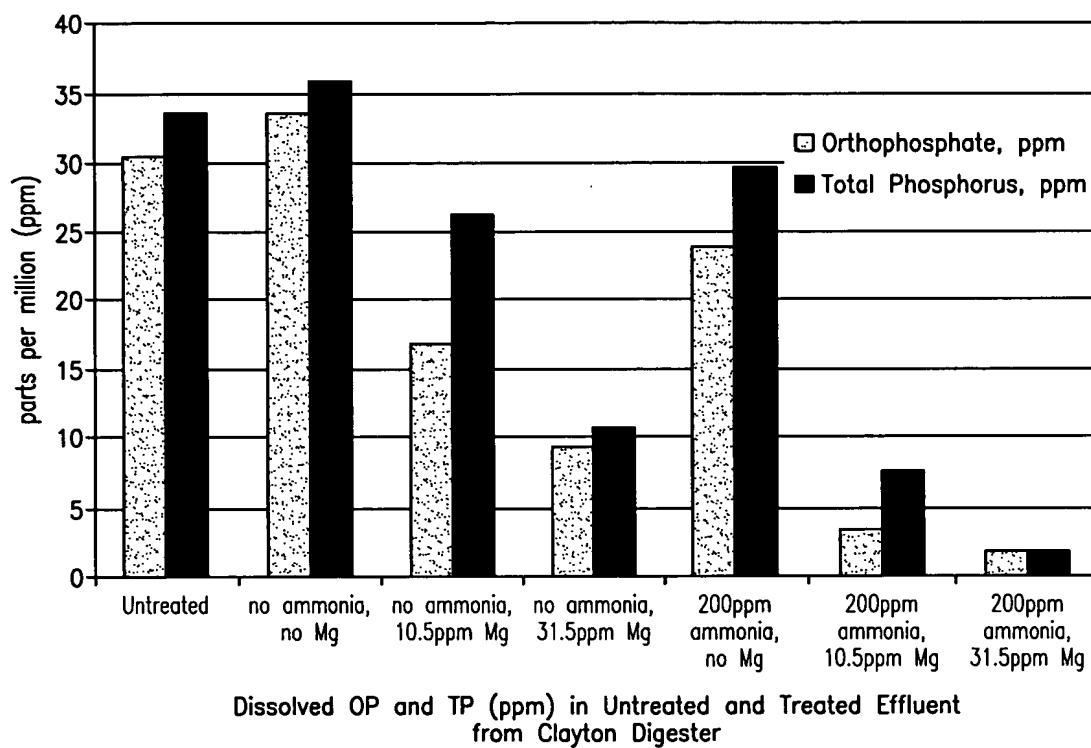


FIG. 5

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REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

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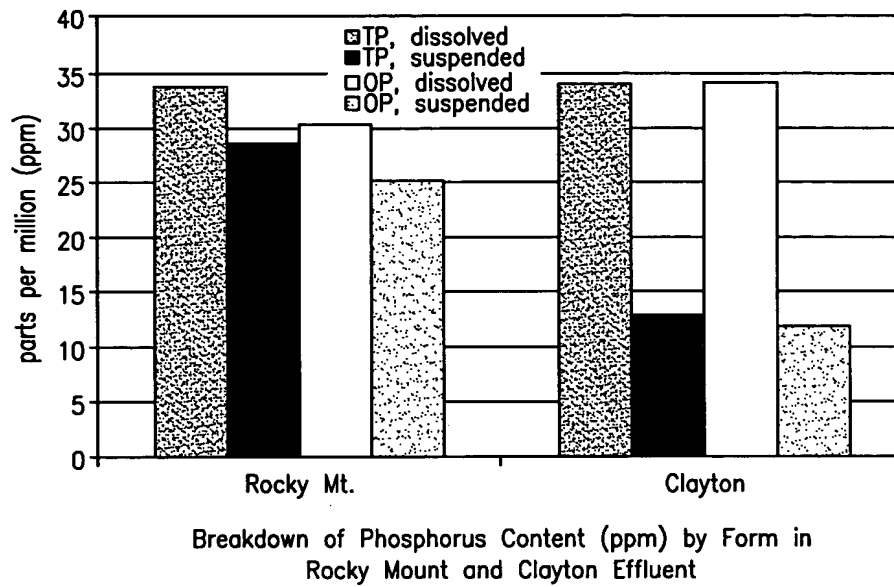


FIG. 6

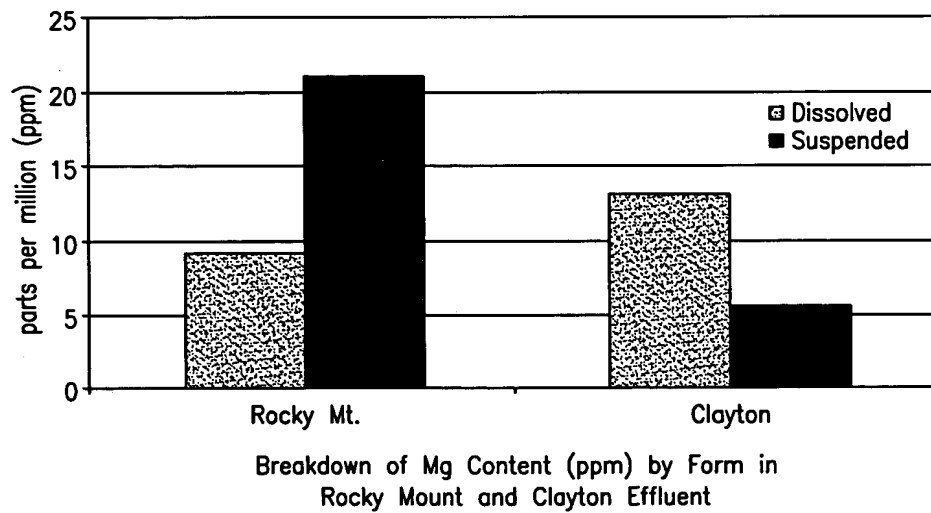


FIG. 7

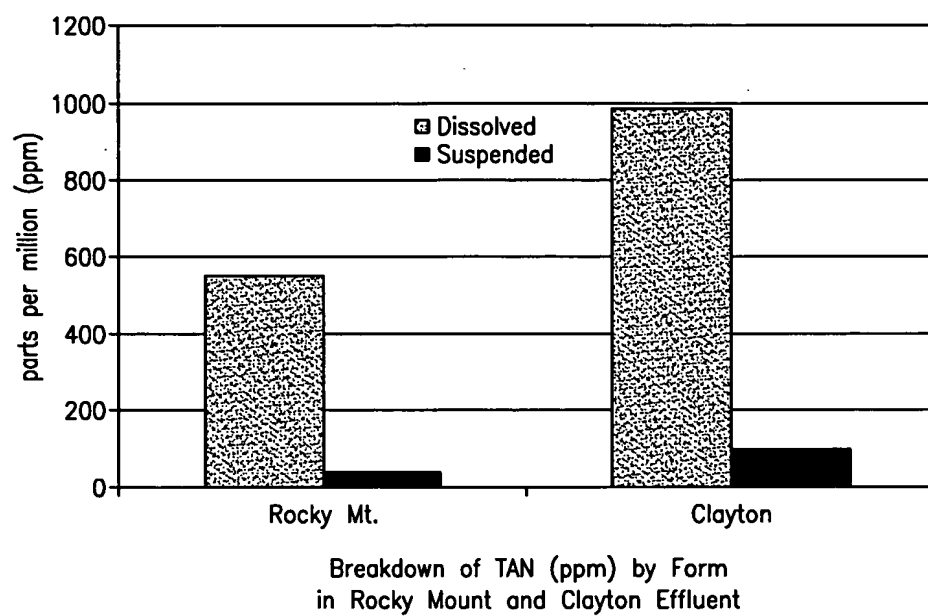


FIG. 8

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

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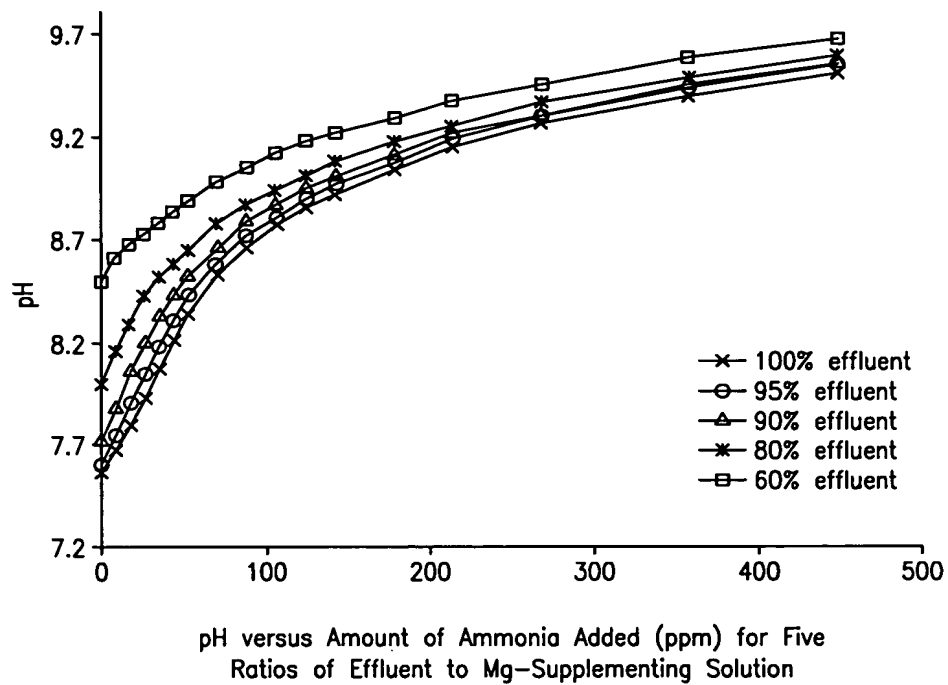


FIG. 9

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

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Atty Docket: 297/181

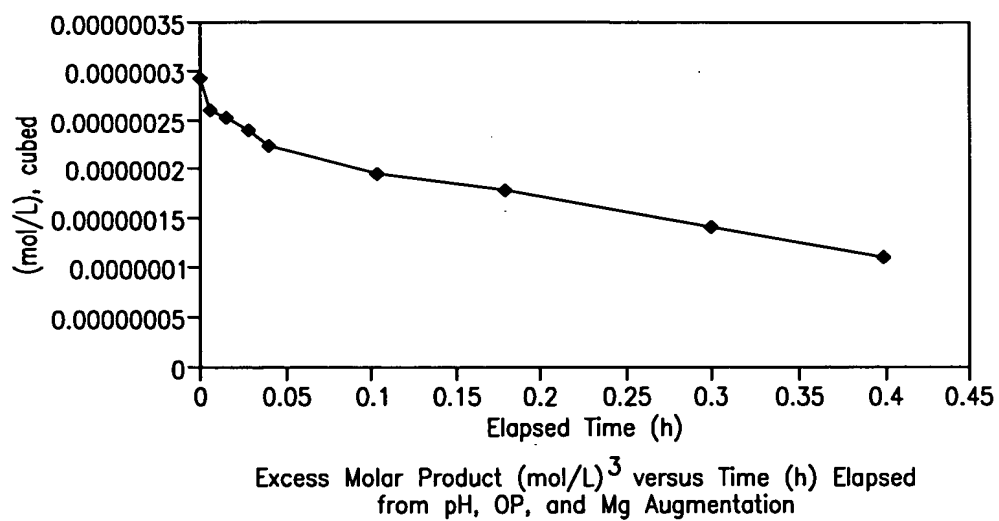
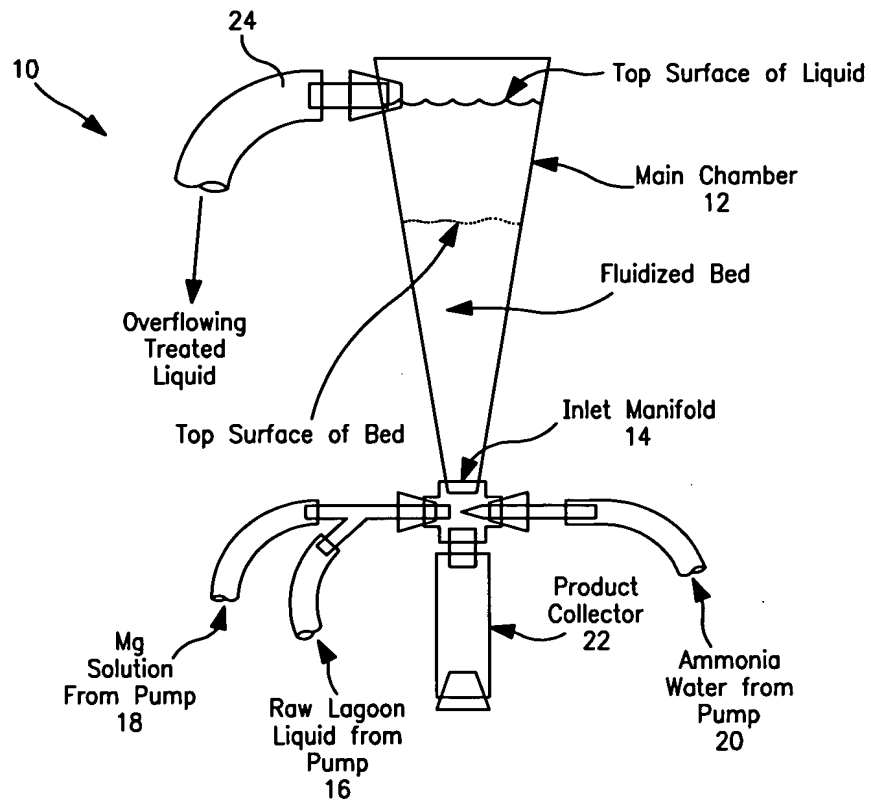


FIG. 10



Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

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Sketch of Laboratory-Scale Continuous Crystallizer

FIG. 11

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

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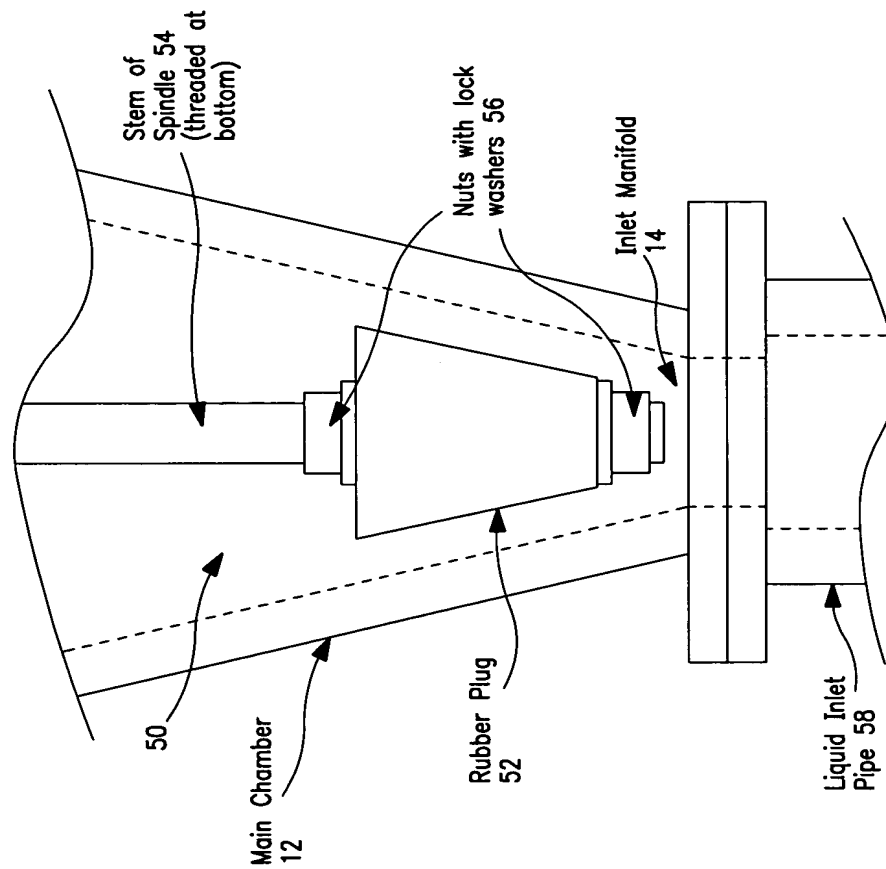
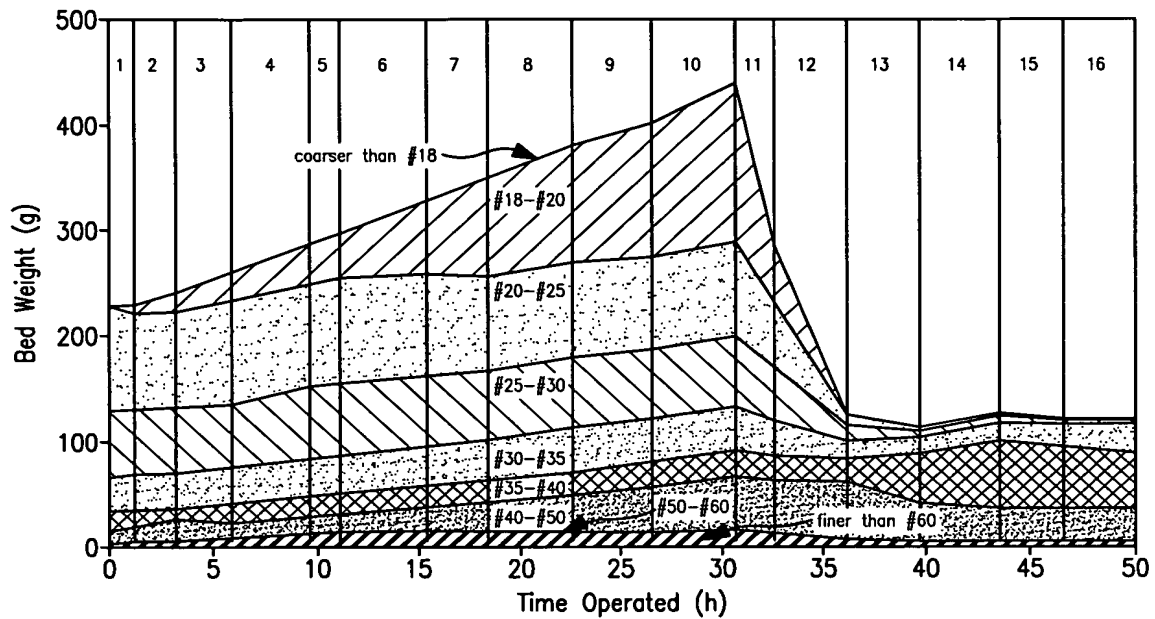


FIG. 1A

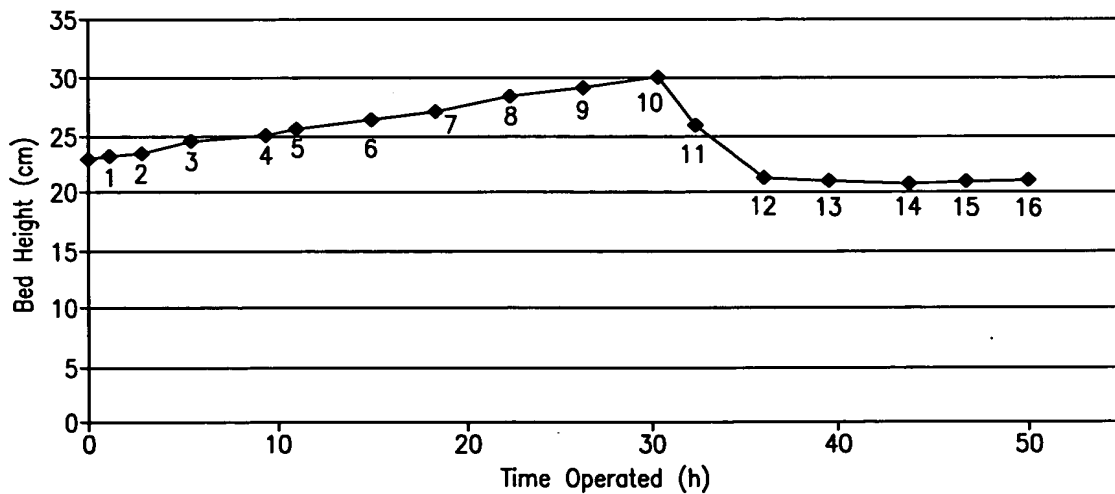
Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
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First Series of FCRs: Bed Weight (g), Broken Down by  
Particle Size (Standard Sieve), vs. Time Operated (h)  
(Numbered Vertical Strips Correspond with Runs)

FIG. 12



First Series of FCRs: Bed Height (cm) at End of Run  
vs. Operating Time (h)  
(Run Numbers Indicated)

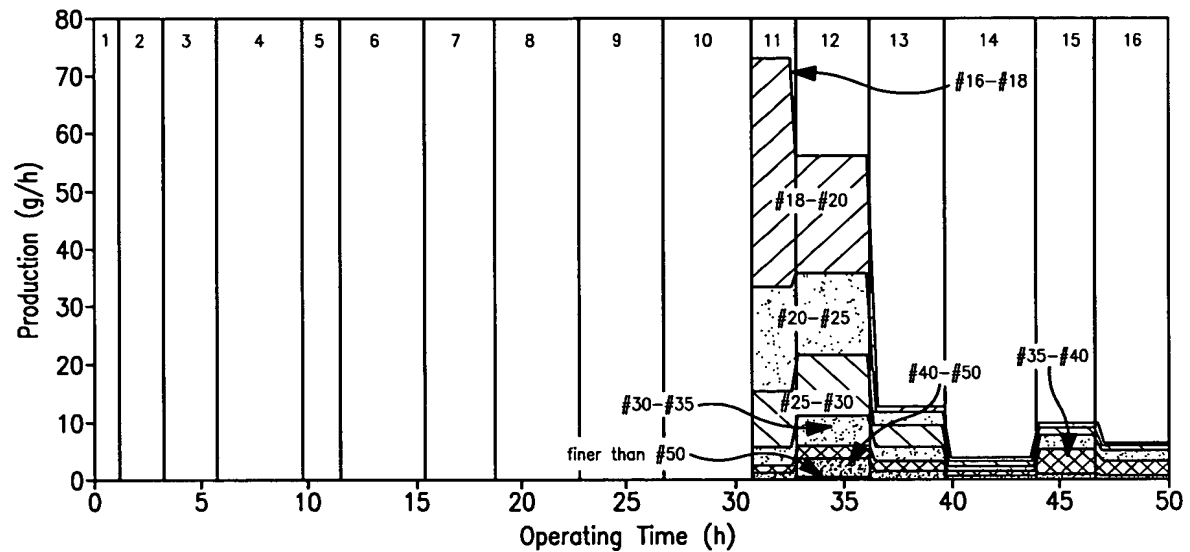
FIG. 13

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

Serial No.: 10/659,239

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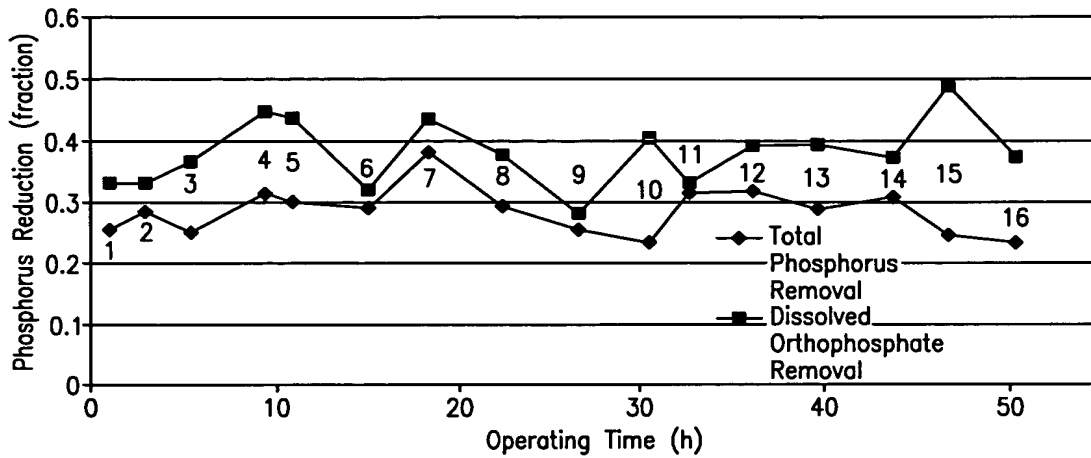


First Series of FCRs: Production (g/h), Averaged Over Each Run,  
Broken Down by Particle Size (Standard Sieve)  
(Numbered Vertical Strips Correspond with Runs)

FIG. 14

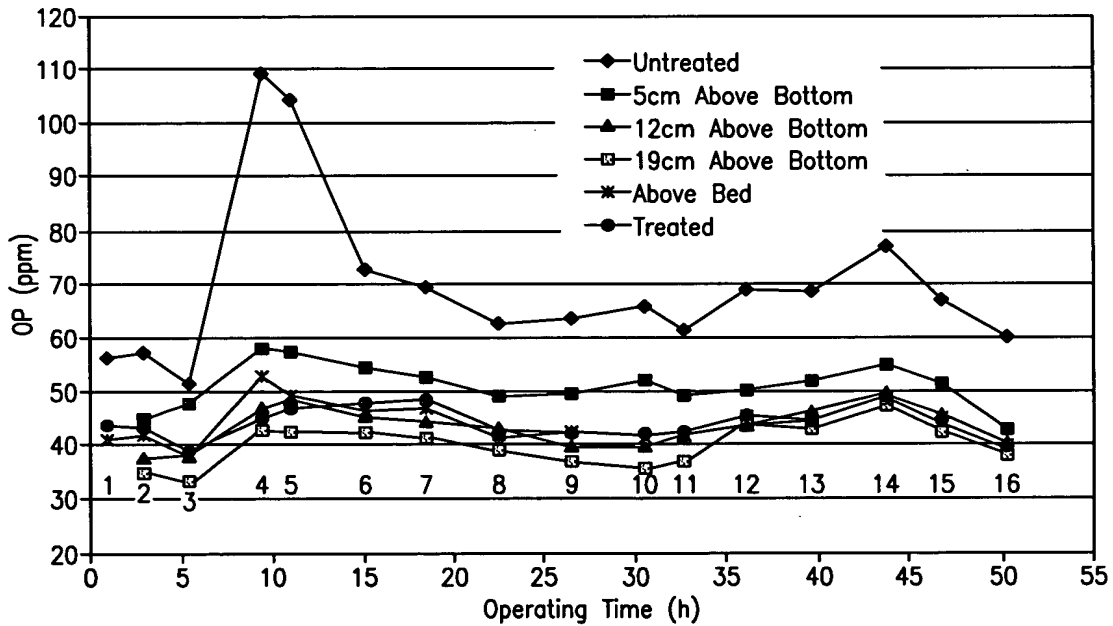
Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
Serial No.: 10/659,239  
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First Series of FCRs: Phosphorus Reduction (fraction) vs.  
Operating Time (h)  
(Run Numbers Indicated)

FIG. 15

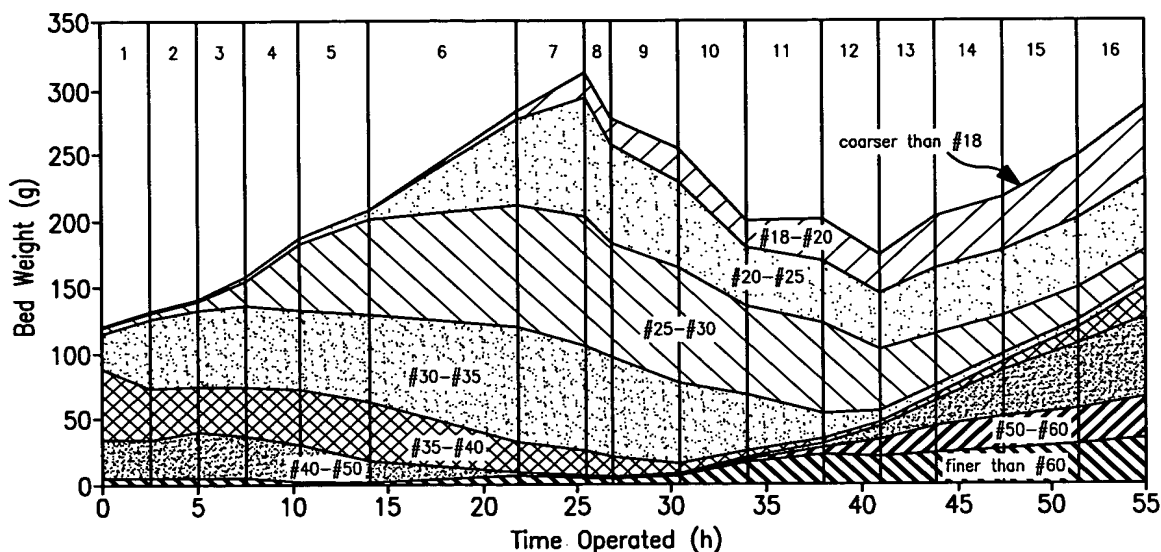


First Series of FCRs: OP (ppm) at Various Sampling Points  
vs. Operating Time (h)  
(Run Numbers Indicated)

FIG. 16

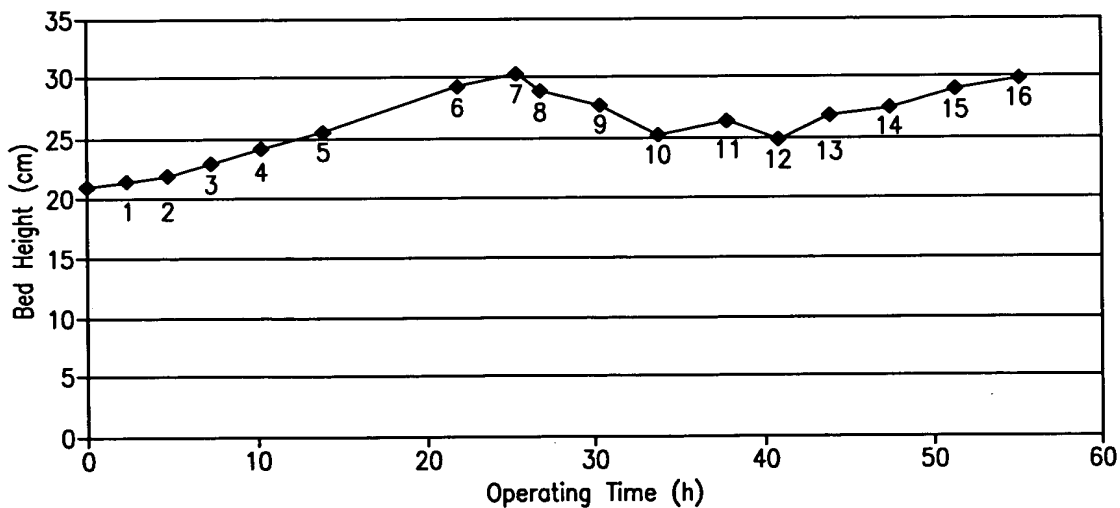
Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
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Second Series of FCRs: Bed Weight (g), Broken Down by  
Particle Size (Standard Sieve), vs. Time Operated (h)  
(Numbered Vertical Strips Correspond with Runs)

FIG. 17

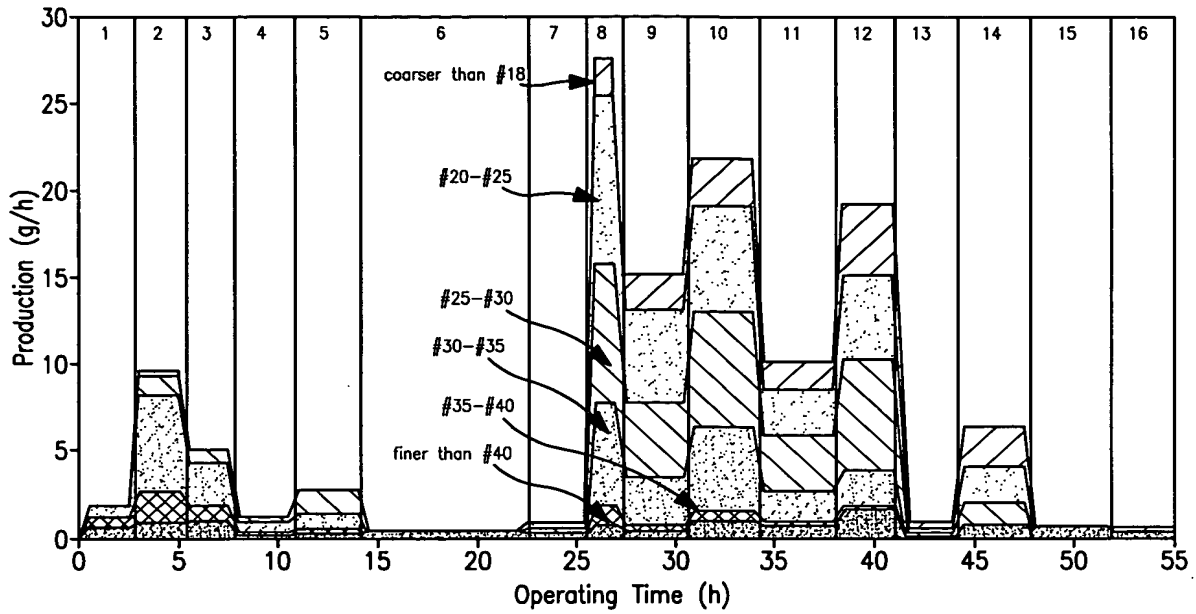


Second Series of FCRs: Bed Height (cm) at End of Run  
vs. Operating Time (h)  
(Run Numbers Indicated)

FIG. 18

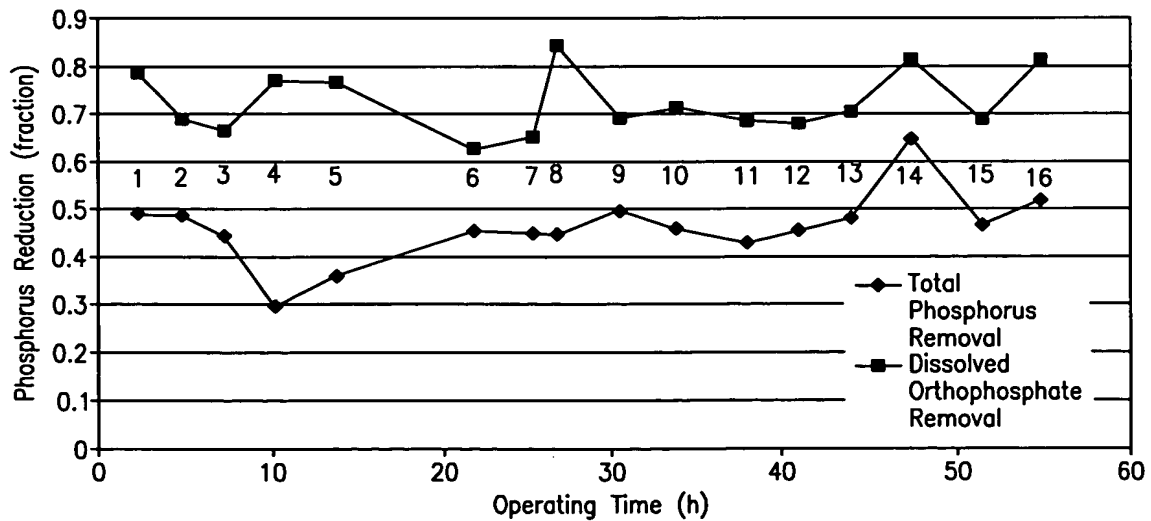
Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
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Second Series of FCRs: Production (g/h), Averaged Over Each Run,  
Broken Down by Particle Size (Standard Sieve)  
(Numbered Vertical Strips Correspond with Runs)

FIG. 19

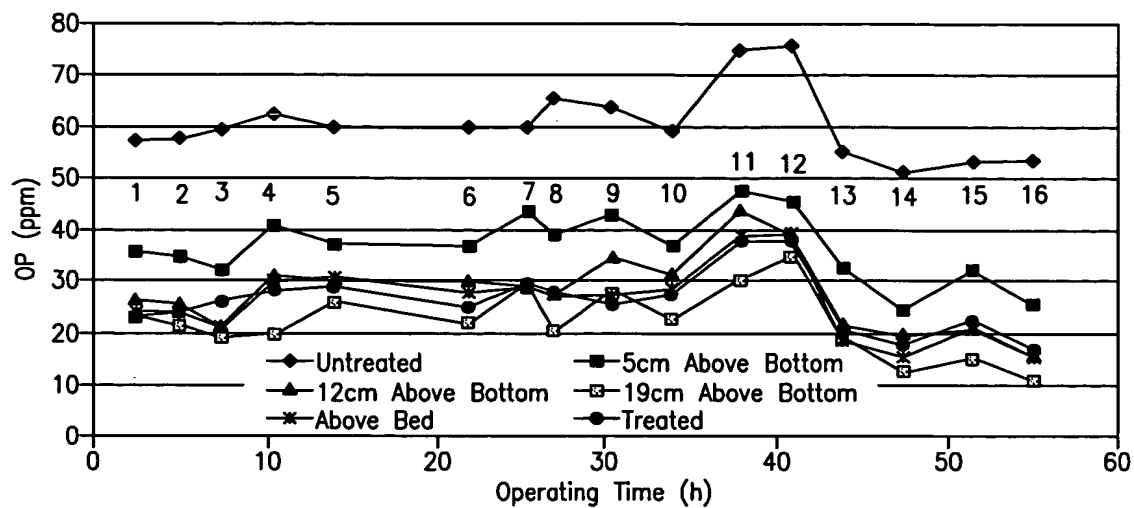


Second Series of FCRs: Phosphorus Reduction (fraction) vs.  
Operating Time (h)  
(Run Numbers Indicated)

FIG. 20

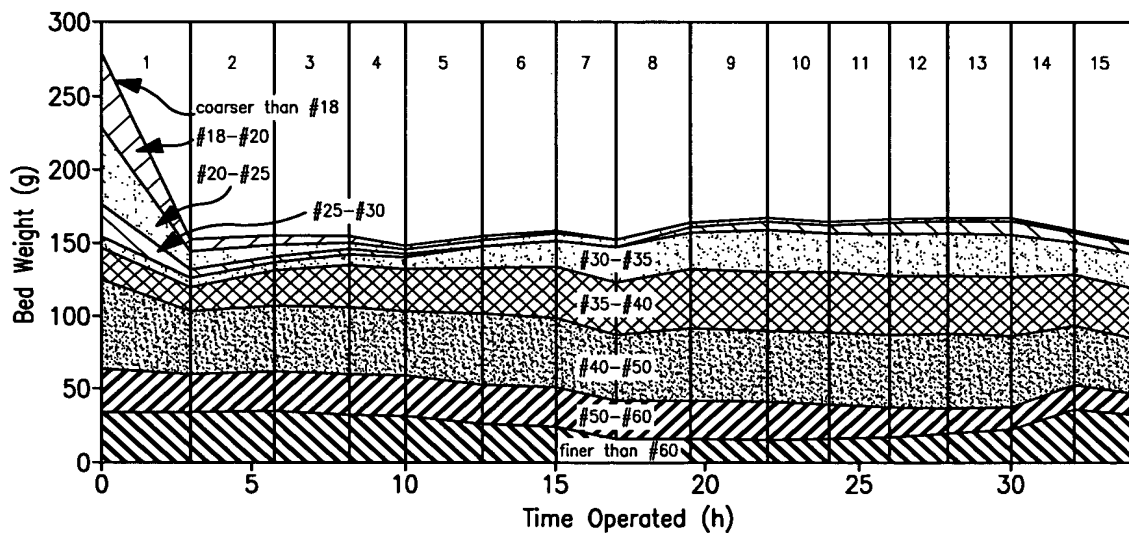
Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

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Second Series of FCRs: OP (ppm) at Various Sampling Points  
vs. Operating Time (h)  
(Run Numbers Indicated)

FIG. 21



Third Series of FCRs: Bed Weight (g), Broken Down by  
Particle Size (Standard Sieve), vs. Time Operated (h)  
(Numbered Vertical Strips Correspond with Runs)

FIG. 22

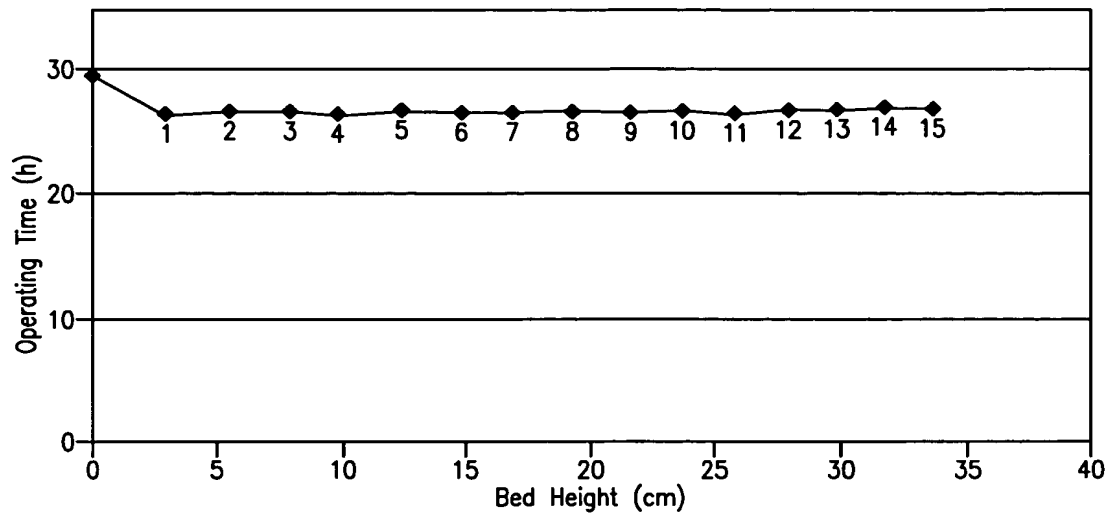


Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

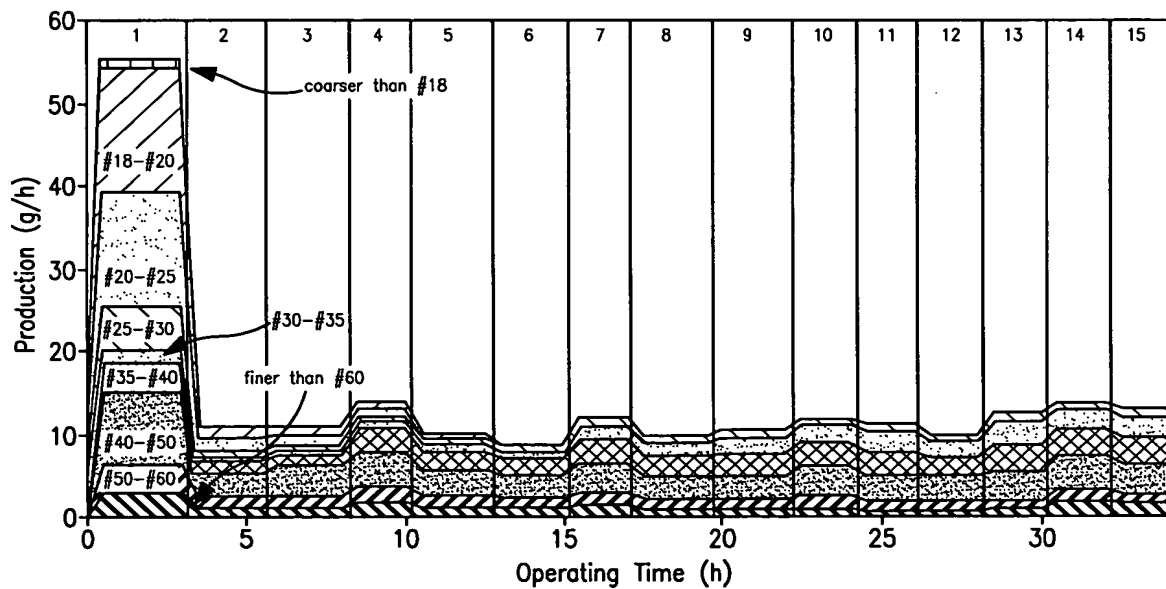
Serial No.: 10/659,239

Atty Docket: 297/181



Third Series of FCRs: Bed Height (cm) at End of Run vs.  
Operating Time (h)  
(Run Numbers Indicated)

FIG. 23

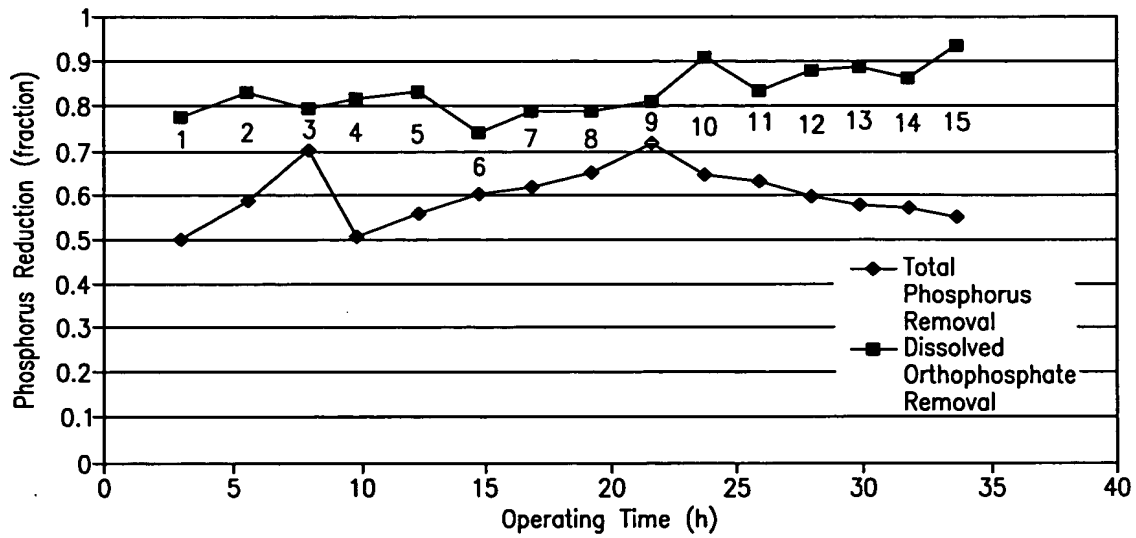


Third Series of FCRs: Production (g/h), Averaged Over Each Run,  
Broken Down by Particle Size (Standard Sieve)  
(Numbered Vertical Strips Correspond with Runs)

FIG. 24

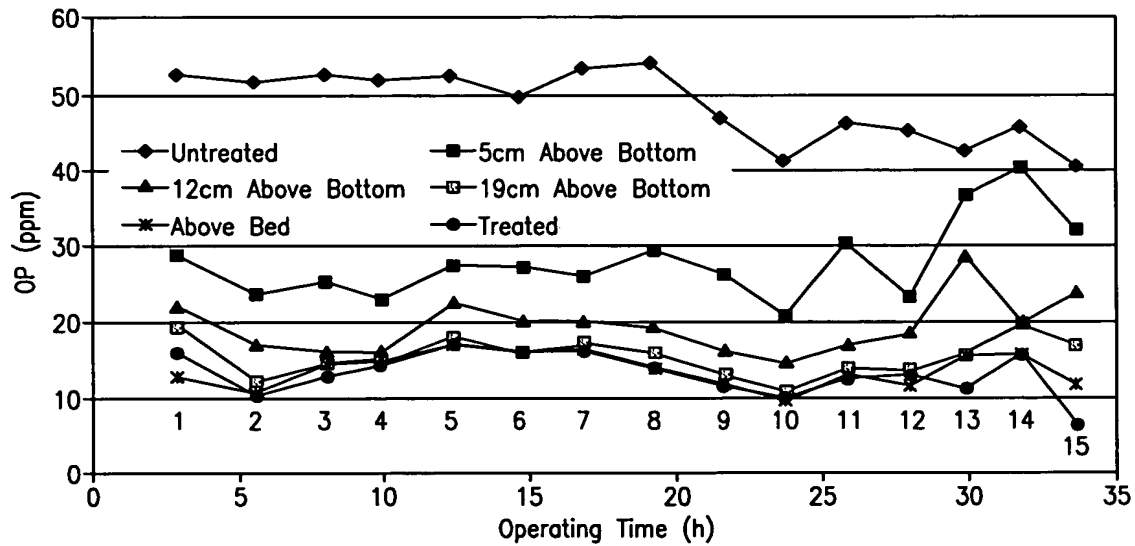
Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
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Third Series of FCRs: Phosphorus Reduction (fraction) vs.  
Operating Time (h)  
(Run Numbers Indicated)

FIG. 25



Third Series of FCRs: OP (ppm) at Various Sampling Points  
vs. Operating Time (h)  
(Run Numbers Indicated)

FIG. 26

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
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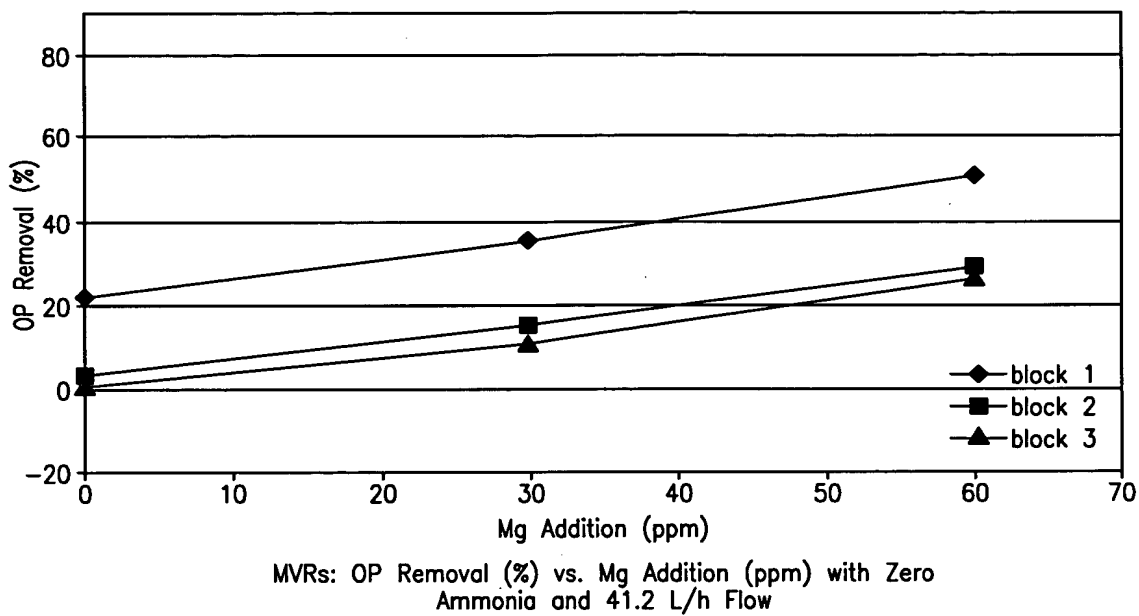


FIG. 27

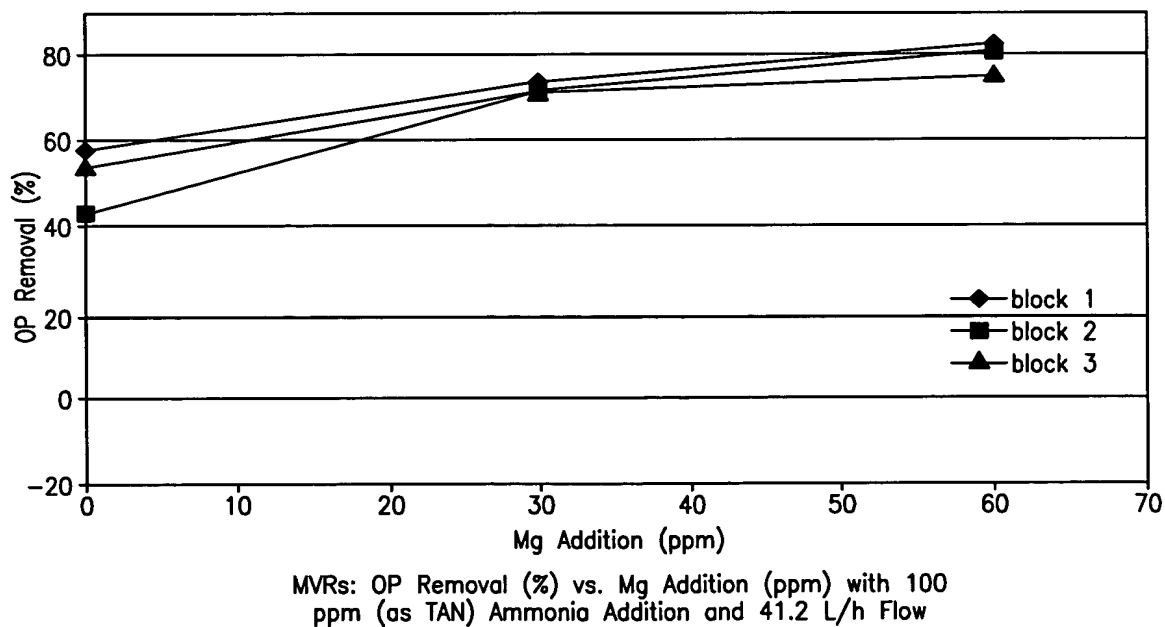


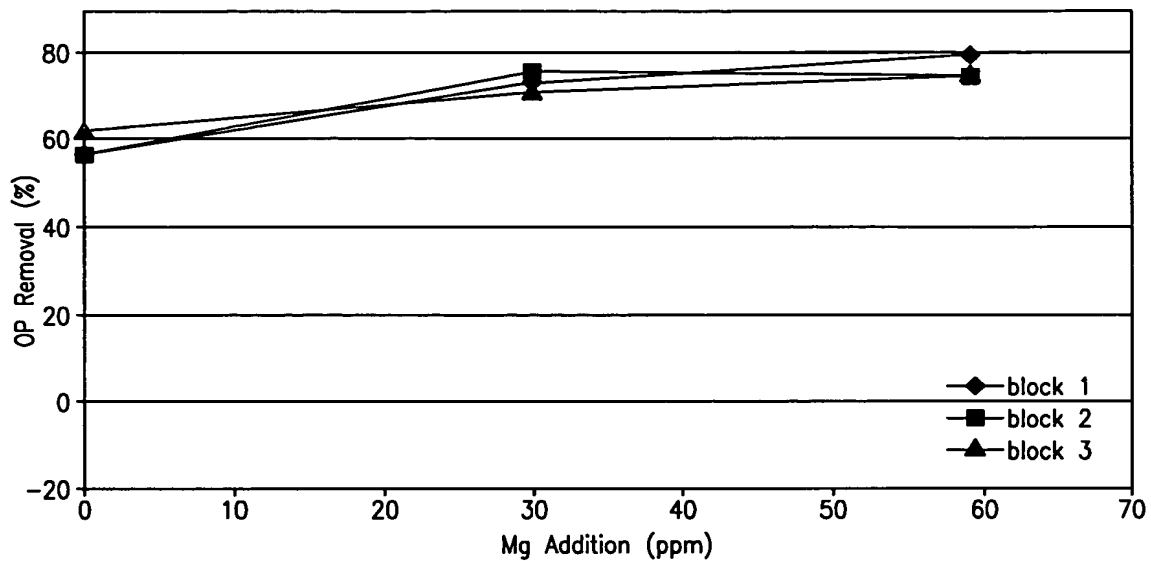
FIG. 28

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

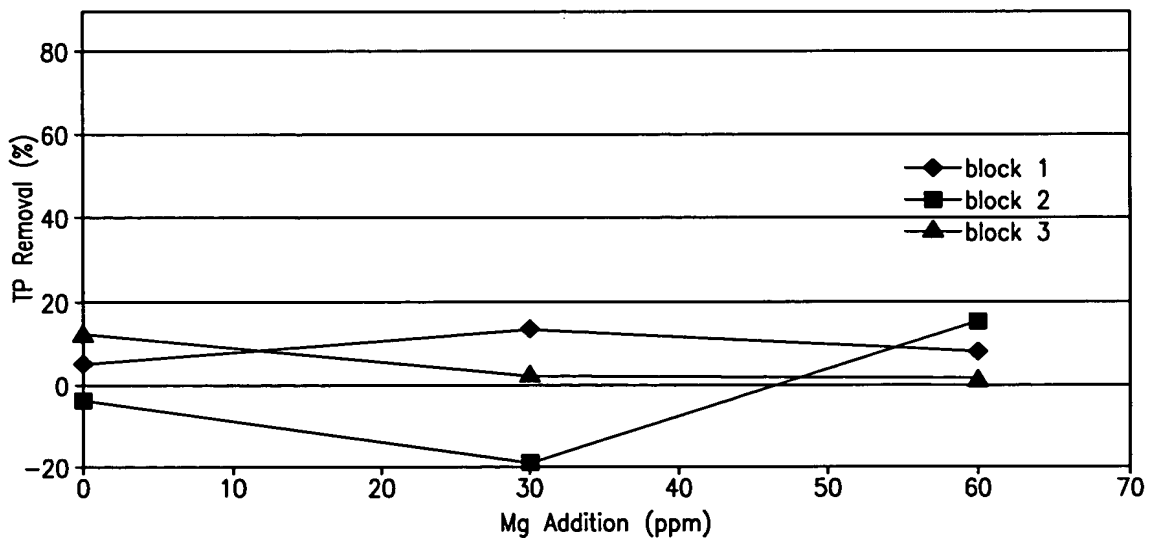
Serial No.: 10/659,239

Atty Docket: 297/181



MVRs: OP Removal (%) vs. Mg Addition (ppm) with 200  
ppm (as TAN) Ammonia and 41.2 L/h Flow

FIG. 29



MVRs: TP Removal (%) vs. Mg Addition (ppm) with Zero  
Ammonia and 41.2 L/h Flow

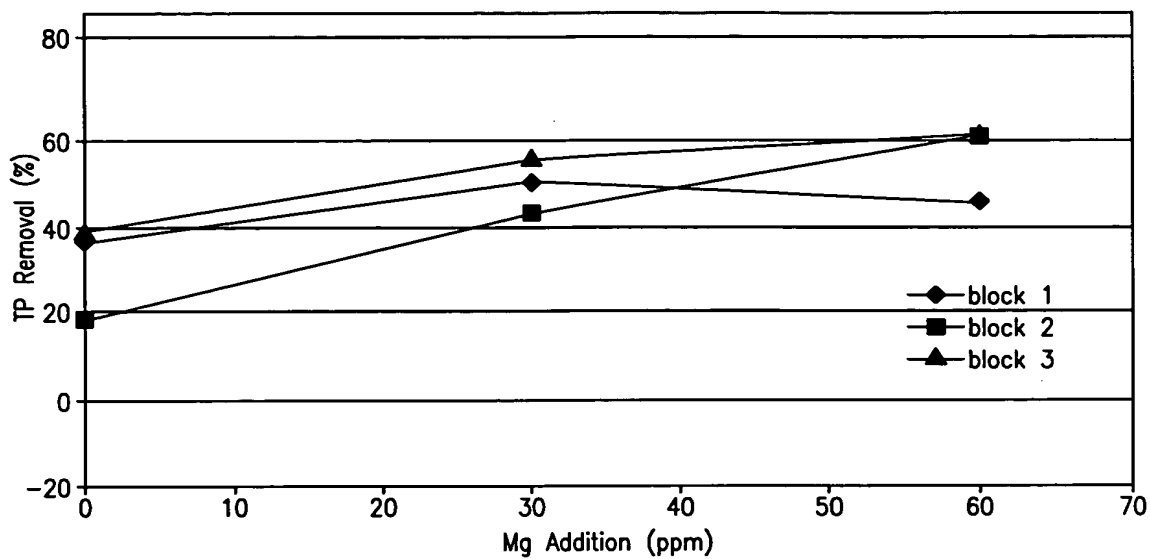
FIG. 30

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

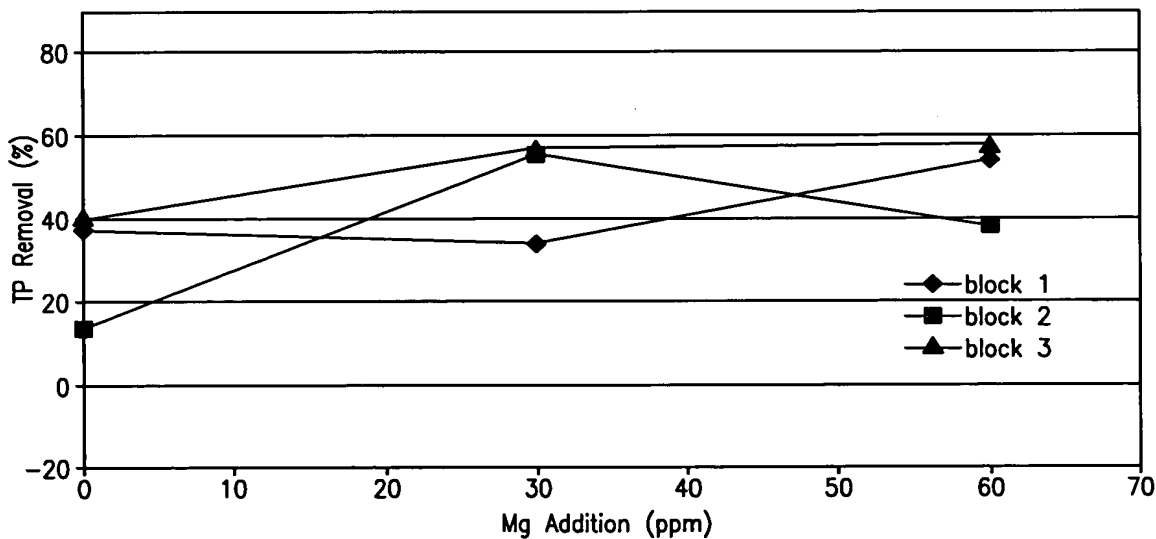
Serial No.: 10/659,239

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MVRs: TP Removal (%) vs. Mg Addition (ppm) with 100 ppm  
(as TAN) Ammonia and 41.2 L/h Flow

FIG. 31



MVRs: TP Removal (%) vs. Mg Addition (ppm) with 200 ppm (as  
TAN) Ammonia and 41.2 L/h Flow

FIG. 32

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.  
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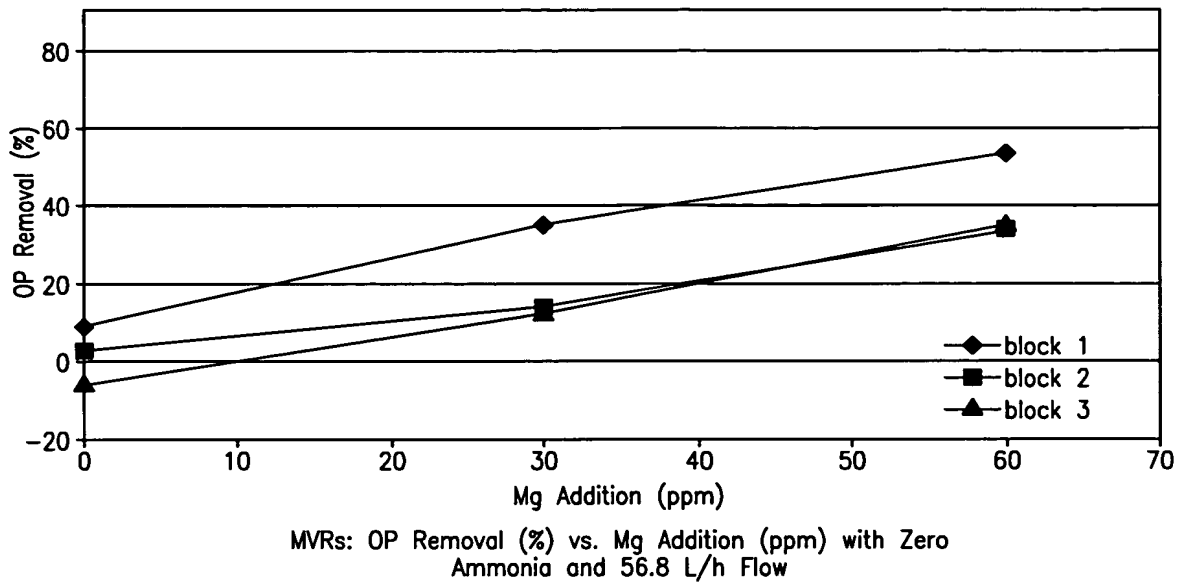


FIG. 33

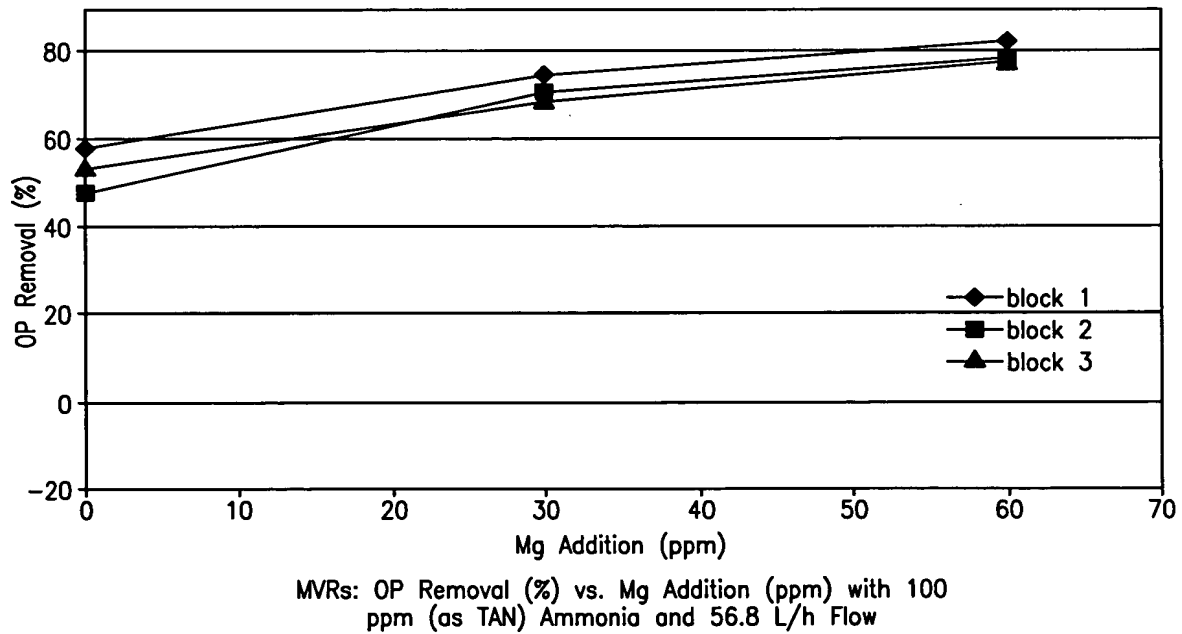


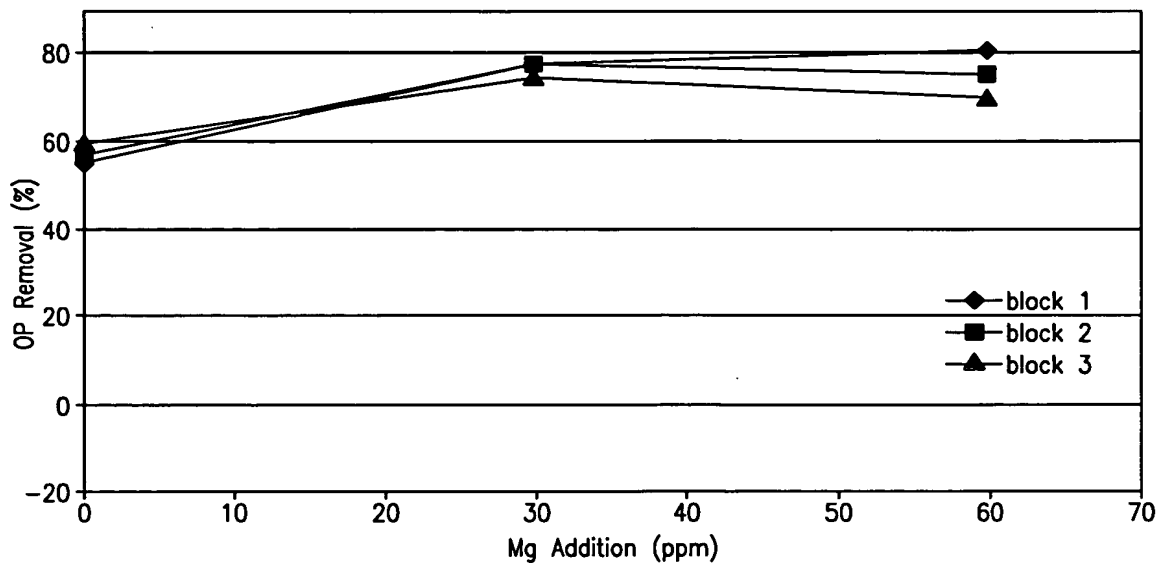
FIG. 34

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

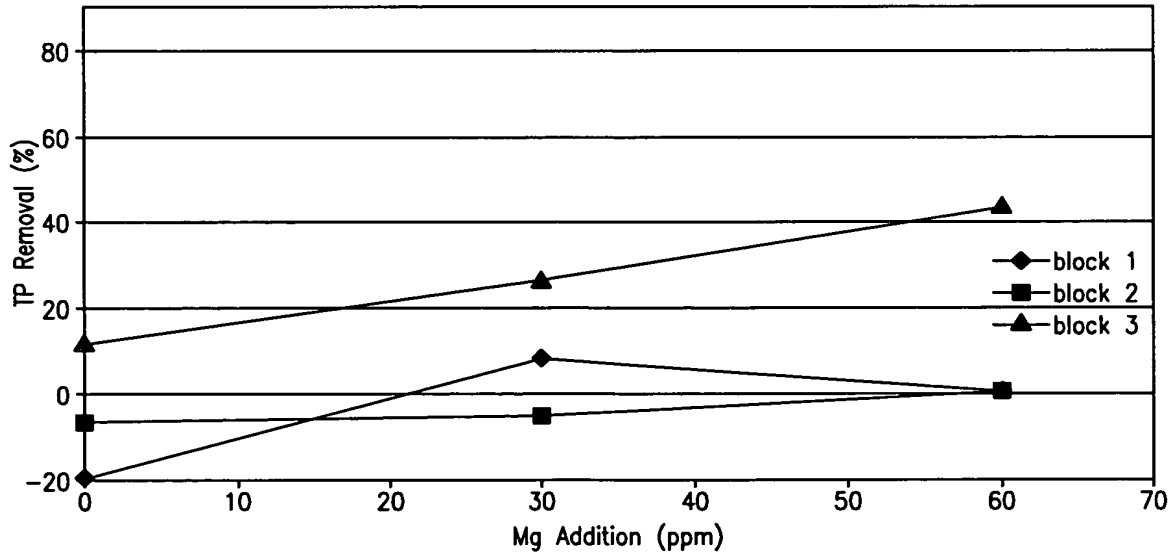
Serial No.: 10/659,239

Atty Docket: 297/181



MVRs: OP Removal (%) vs. Mg Addition (ppm) with 200  
ppm (as TAN) Ammonia and 56.8 L/h Flow

FIG. 35



MVRs: TP Removal (%) vs. Mg Addition (ppm) with Zero  
Ammonia and 56.8 L/h Flow

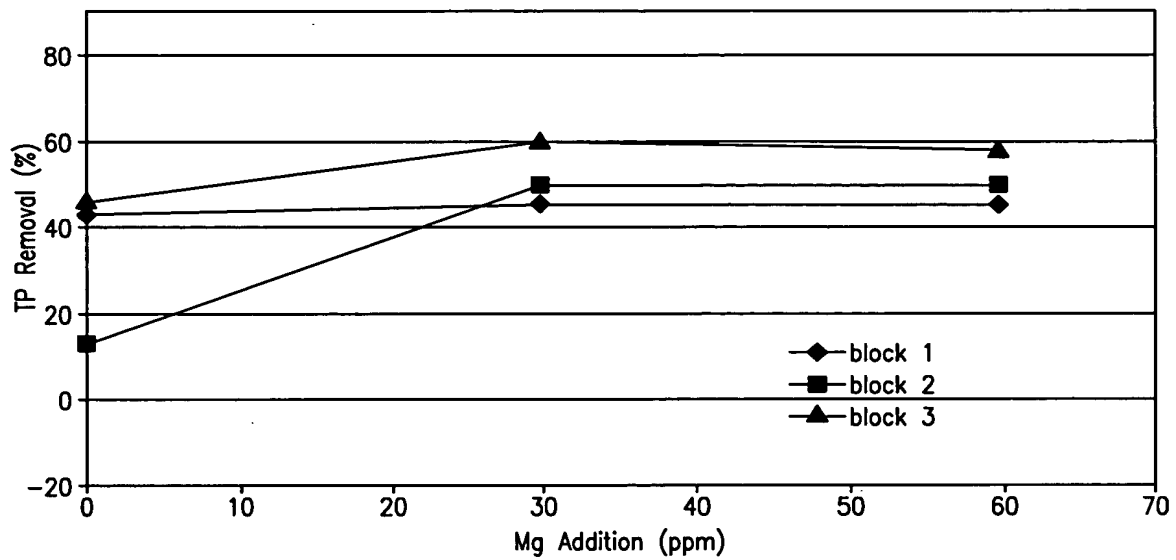
FIG. 36

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al.

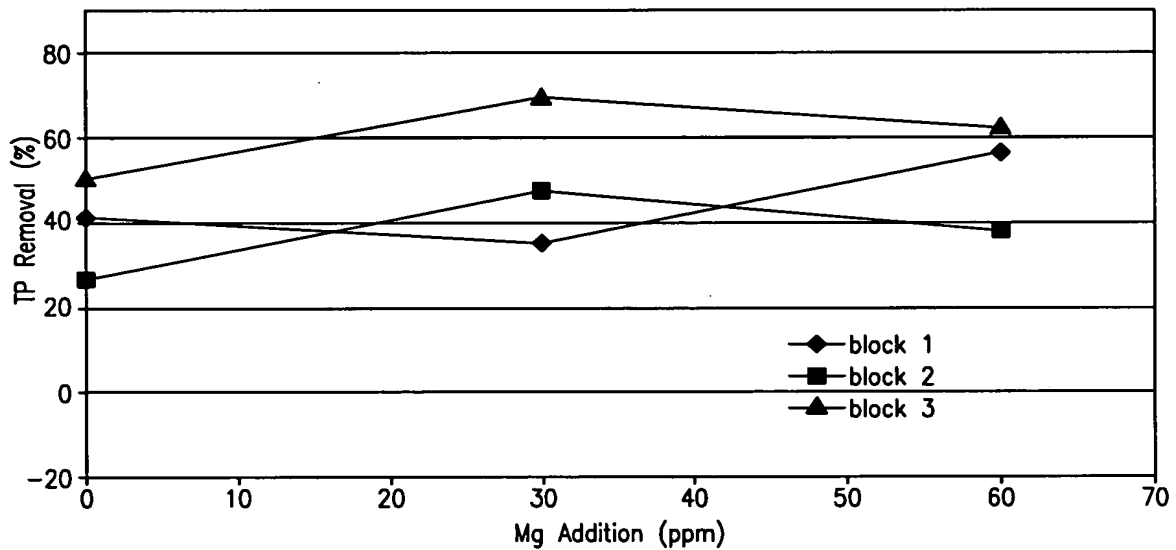
Serial No.: 10/659,239

Atty Docket: 297/181



MVRs: TP Removal (%) vs. Mg Addition (ppm) with 100  
ppm (as N) Ammonia and 56.8 L/h Flow

FIG. 37

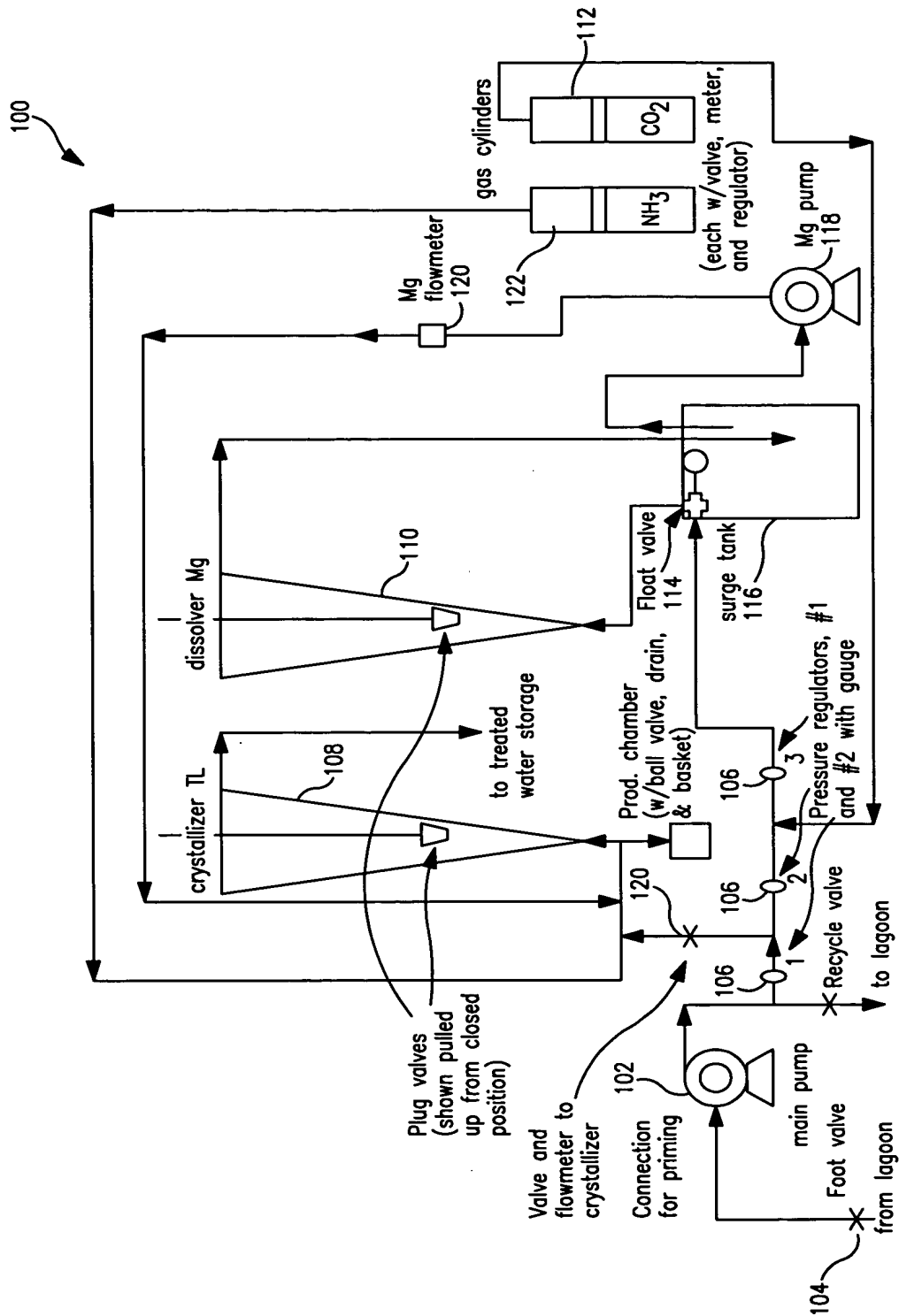


MVRs: TP Removal (%) vs. Mg Addition (ppm) with 200  
ppm (as N) Ammonia and 56.8 L/h Flow

FIG. 38



Applicant: Bowers et al. .  
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### Schematic Representation of Field-Scale Crystallizer, Showing Principal Components

FIG. 39

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

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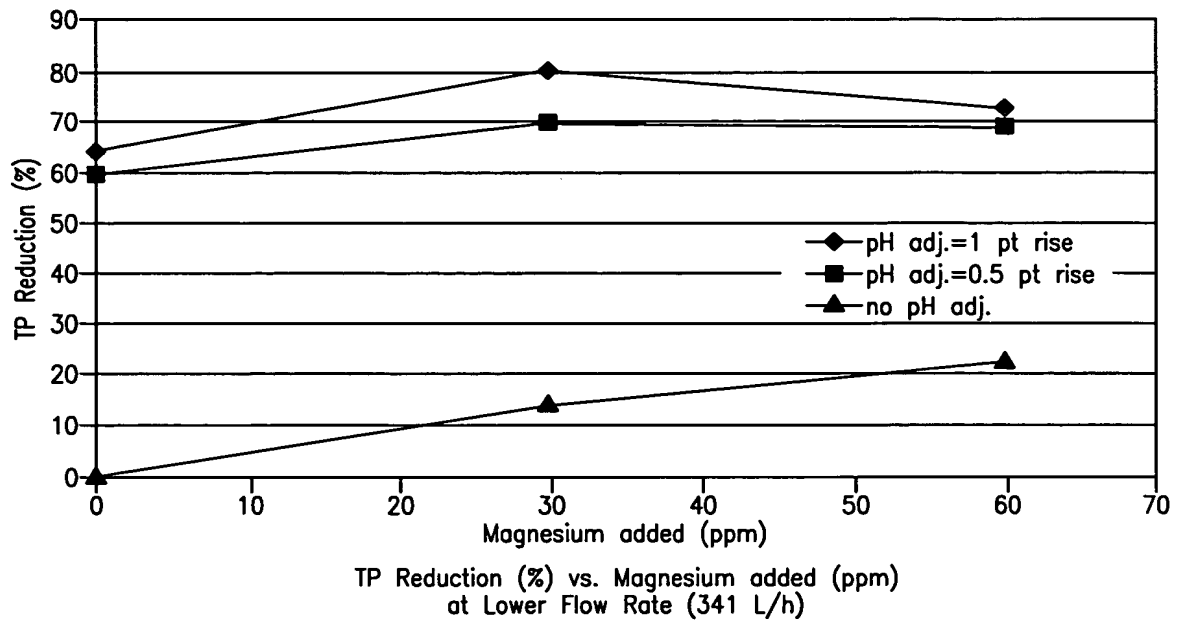


FIG. 40

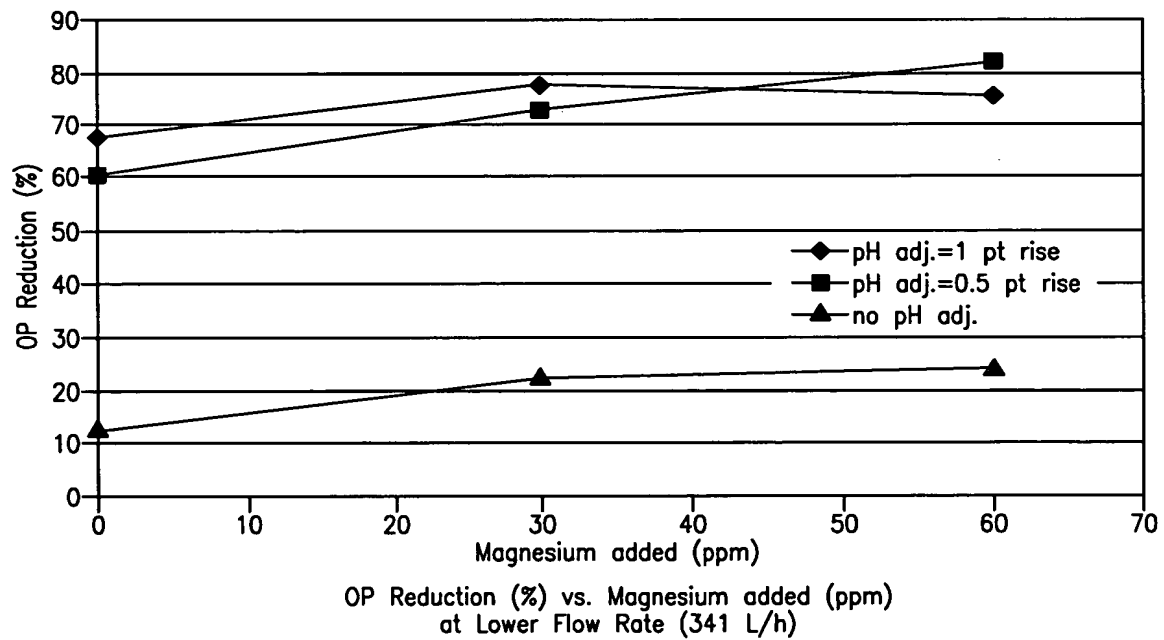


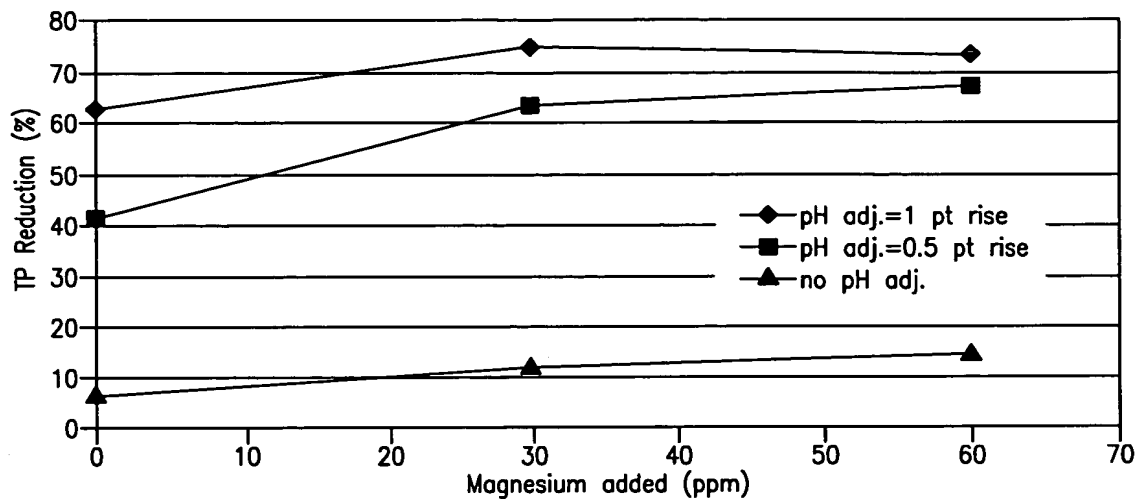
FIG. 41

Title: APPARATUS AND METHOD FOR  
REMOVING PHOSPHORUS FROM  
WASTE LAGOON EFFLUENT

Applicant: Bowers et al. -

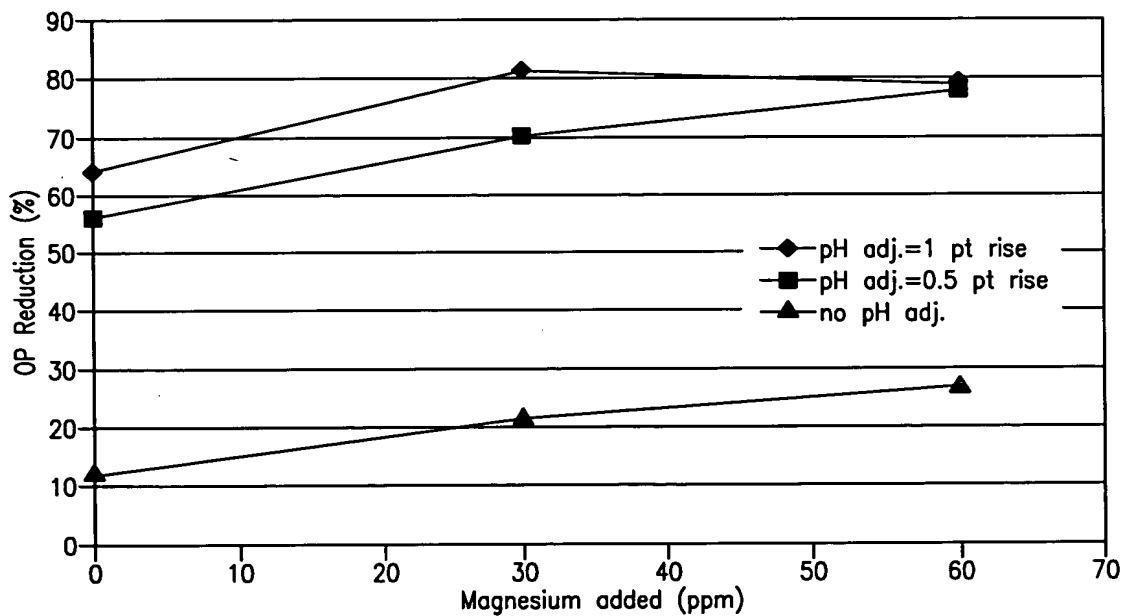
Serial No.: 10/659,239

Atty Docket: 297/181



TP Reduction (%) vs. Magnesium added (ppm)  
at Higher Flow Rate (568 L/h)

FIG. 42



OP Reduction (%) vs. Magnesium added (ppm)  
at Higher Flow Rate (568 L/h)

FIG. 43